

TEXAS INSTRUMENTS

S O F T W A R E

**QUICK
REFERENCE
TABLES**



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TEXAS INSTRUMENTS

TI-95

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QUICK REFERENCE TABLES

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Refer to the TI-95 Chemical Engineering Library Guidebook for complete instructions on how to use the programs and for explanations and sources of these tables.

Menu of Programs

Press **[RUN]** <CHE> to display the **CHEM ENGINEERING** menu. The selections you can make are shown below.

<PRP>	Properties Table		
	Gas	Viscosity	
		Thermal Conductivity	
	Liquid	Viscosity	
		Thermal Conductivity	
		Density	
	Other	Vapor Pressure and Raoult's Law K-Value	
		Critical Properties	
		Latent Heat of Vaporization	
	<THM>	Soave-Redlich-Kwong Thermodynamics	
Peng-Robinson Thermodynamics			
Specific Heat			
<DSN>	Pipe Design for Liquid Flow		
	Absorber Design		
	Distillation Design		
	Heat Exchanger Design		
	Heat Transfer Coefficient Estimation		
<OTH>	Equilibrium Flash Calculation		
	Activity Coefficient		

List of Built-in Compounds

Compound Name	Selection Number	Compound Name	Selection Number
A		B (continued)	
acetaldehyde	208	sec-butanol	186
acetic acid	201	tert-butanol	187
anhydride acetic acid (acetic anhydride)	258	1-butene	52
butyl ester acetic acid (n-butyl acetate)	225	isobutene	55
ethyl ester acetic acid (ethyl acetate)	223	2,3-dimethyl 1-butene	72
methyl ester acetic acid (methyl acetate)	221	3,3-dimethyl 1-butene	73
propyl ester acetic acid (n-propyl acetate)	224	2-methyl 1-butene	59
acetone	211	3-methyl 1-butene	60
acetonitrile	249	cis 2-butene	53
acetyl chloride	160	trans 2-butene	54
acetylene	127	2,3-dimethyl 2-butene	74
dimethylacetylene	130	2-methyl 2-butene	61
ethylacetylene	129	n-butyl amine	239
methylacetylene	128	isobutyl amine	240
acrolein	254	n-butyraldehyde	210
acrylic acid	206	butyric acid	203
ethyl ester acrylic acid (ethyl acrylate)	231	methyl ester butyric acid (methyl n-butyrate) *	228
methyl ester acrylic acid (methyl acrylate)	230	isobutyric acid	204
allyl chloride	157	butyronitrile	251
aniline	243		
N,N-dimethylaniline *	247	C	
B		cumene	139
benzene	132	cyclobutane	95
bromobenzene	169	cyclohexane	113
n-butylbenzene	143	n-butylcyclohexane	124
chlorobenzene	167	1,1-dimethylcyclohexane	116
fluorobenzene	168	cis 1,2-dimethyl-cyclohexane	117
hexafluorobenzene	171	trans 1,2-dimethyl-cyclohexane	118
iodobenzene	170	cis 1,3-dimethyl-cyclohexane	119
1-methyl-2-ethylbenzene	140	trans 1,3-dimethyl-cyclohexane	120
1-methyl-3-ethylbenzene	141	cis 1,4-dimethyl-cyclohexane	121
1-methyl-4-ethylbenzene	142	trans 1,4-dimethyl-cyclohexane	122
n-propylbenzene	138	ethylcyclohexane	115
biphenyl	145	methylcyclohexane	114
1,2-butadiene	87	cyclohexanol	192
3-methyl 1,2-butadiene	92	n-propylcyclohexane	123
1,3-butadiene	88	cyclohexene	126
n-butane	4	cyclopentane	96
i-butane	5	1,1-dimethylcyclopentane	99
2,2-dimethylbutane	12	cis 1,2-dimethyl-cyclopentane	100
2,3-dimethylbutane	13	trans 1,2-dimethyl-cyclopentane	101
2,2,3,3-tetramethylbutane	22	ethylcyclopentane	98
2,2,3-trimethylbutane	15	methylcyclopentane	97
n-butanol	184		
isobutanol	185		

(continued)

List of Built-in Compounds (Continued)

Compound Name	Selection Number	Compound Name	Selection Number
C (continued)		F	
<i>n</i> -decylcyclopentane	107	formaldehyde	207
<i>n</i> -dodecylcyclopentane	108	formic acid	200
<i>n</i> -heptylcyclopentane	104	ethyl ester formic acid (ethyl formate)	219
<i>n</i> -hexadecylcyclopentane	112	methyl ester formic acid (methyl formate)	218
<i>n</i> -hexylcyclopentane	103	propyl ester formic acid (<i>n</i> -propyl formate)	220
<i>n</i> -nonylcyclopentane	106	furan	255
<i>n</i> -octylcyclopentane	105	G	glycerine 197
<i>n</i> -pentadecylcyclopentane	111		
<i>n</i> -propylcyclopentane	102		
<i>n</i> -tetradecylcyclopentane	110		
<i>n</i> -tridecylcyclopentane	109	H	
cyclopentene	125	<i>n</i> -heptadecane	46
cyclopropane	94	2-methylheptane	23
D		3-methylheptane	24
<i>n</i> -decane	39	4-methylheptane	25
1-decanol	193	<i>n</i> -heptane	14
1-decene	78	1-heptanol	190
dibutyl amine	248	1-heptene	75
diethyl amine	241	<i>n</i> -hexadecane	45
diethyl ether	217	1-hexadecene	84
diethyl ketone	213	<i>n</i> -hexane	9
diethylene glycol	195	2,2-dimethylhexane	27
dimethyl amine	233	2,3-dimethylhexane	28
dimethyl ether	215	2,4-dimethylhexane	29
dimethyl sulfide	261	2,5-dimethylhexane	30
1,4-dioxane	257	3,3-dimethylhexane	31
diphenyl	145	3,4-dimethylhexane	32
dipropyl amine	244	3-ethylhexane	26
<i>n</i> -dodecane	41	3-methylhexane	16
1-dodecene	80	2,2,5-trimethylhexane	38
E		1-hexanol	189
<i>n</i> -eicosane	49	1-hexene	62
ethane	2	<i>cis</i> 2-hexene	63
chloroethane	153	<i>trans</i> 2-hexene	64
1,1-dichloroethane	154	<i>cis</i> 3-hexene	65
1,2-dichloroethane	155	<i>trans</i> 3-hexene	66
1,2-dichloro-1,1,2,2-tetrafluoroethane (R114)	178	I	isoprene 93
1,1,2-trichloroethane	156		
1,1,2-trichloro-1,2,2-trifluoroethane (R113)	177		
trichloroethylene	151		
ethanol	181	M	
ethyl amine	234	methane	1
ethylbenzene	134	chlorodifluoro-	
ethyl bromide	166	methane (R22)	176
ethylene	50	chlorotrifluoro-	
perchloroethylene	152	methane (R13)	174
ethylenediamine	235	dichlorodifluoro-	
1,1-difluoroethylene	164	methane (R12)	173
ethylene glycol	194	dichloromonofluoro-	
ethylene imine	253	methane (R21)	175
ethylene oxide	198	nitromethane	252
ethyl mercaptan	260	tetrachloromethane (carbon tetrachloride)	149

Compound Name	Selection Number	Compound Name	Selection Number
M (continued)		P (continued)	
tetrafluoromethane (carbon tetrafluoride) (R14)	162	2-methyl 2-pentene	67
trichloromethane (chloroform)	148	<i>cis</i> 3-methyl 2-pentene	68
trichlorofluoromethane (R11)	172	<i>trans</i> 3-methyl 2-pentene	69
trifluorobromomethane	179	<i>cis</i> 4-methyl 2-pentene	70
methanol	180	<i>trans</i> 4-methyl 2-pentene	71
methyl amine	232	1-pentyne	131
methyl bromide	165	phosgene	159
methyl isobutyl ketone	214	propadiene	86
methyl isobutyrate *	229	propane	3
methyl chloride	146	1,2-dichloropropane	158
methyl ethyl ether	216	<i>n</i> -propanol	182
methyl ethyl ketone	212	isopropanol	183
methyl fluoride	161	2-propanol	191
methyl mercaptan	259	propionaldehyde	209
methylene chloride	147	propionic acid	202
methylphenyl amine *	246	ethyl ester propionic acid (ethyl propionate)	227
N		methyl ester propionic acid (methyl propionate)	226
neopentane	8	propionitrile	250
<i>n</i> -nonadecane	48	<i>n</i> -propyl amine	236
<i>n</i> -nonane	37	isopropyl amine	237
1-nonene	77	propylene	51
O		propylene glycol (1,2-propanediol)	196
<i>n</i> -octadecane	47	propylene oxide	199
1-octadecene	85	pyridine	242
<i>n</i> -octane	21	S	
1-octene	76	styrene	144
P		T	
<i>n</i> -pentadecane	44	<i>n</i> -tetradecane	43
1-pentadecene	83	1-tetradecene	82
1,2-pentadiene	89	tetrahydrofuran	256
<i>trans</i> 1,3-pentadiene	90	toluene	133
1,4-pentadiene	91	<i>n</i> -tridecane	42
<i>n</i> -pentane	6	1-tridecene	81
i-pentane	7	triethyl amine	245
3,3-dimethylpentane	20	trimethyl amine	238
2,3-dimethylpentane	18	U	
2,4-dimethylpentane	19	<i>n</i> -undecane	40
3-ethylpentane	17	1-undecene	79
2-methylpentane	10	V	
2-methyl-3-ethylpentane	33	valeric acid	205
3-methylpentane	11	vinyl acetate	222
3-methyl-3-ethylpentane	34	vinyl chloride	150
2,3,3-trimethylpentane	35	vinyl fluoride *	163
2,3,4-trimethylpentane	36	X	
1-pentanol	188	o-xylene	135
1-pentene	56	m-xylene	136
<i>cis</i> 2-pentene	57	p-xylene	137
<i>trans</i> 2-pentene	58		

Tables for Liquid Viscosity

Table of Structural Contributions

Structural Component	Contribution	Structural Component	Contribution
C	-0.462	Double bond	0.478
H	0.249	CO ₆ HO ₅	0.385
O	0.054	S	0.043
Cl	0.340	CO (ketones)	0.105
Br	0.326	CO (esters)	0.105
I	0.335	CN (nitrile)	0.381

Table of Group Contributions

Group	A	B
$\begin{array}{c} \\ \text{R}-\text{C}-\text{R} \\ \\ \text{R} \end{array}$	-0.15	35
$\begin{array}{c} \text{R} \\ \\ \text{R}-\text{C}-\text{R} \\ \\ \text{R} \end{array}$	-1.20	400
Double bond	0.24	-90
Five-membered ring	0.10	32
Six-membered ring	-0.45	250
Aromatic ring	0	20
Ortho substitution	-0.12	100
Meta substitution	0.05	-34
Para substitution	-0.01	-5
Chlorine	-0.61	220
Bromine	-1.25	365
Iodine	-1.75	400
-OH (alcohol)	-3.00	1600
-COO- (ester)	-1.00	420
-O- (ether)	-0.38	140
$\begin{array}{c} \text{O} \\ \\ -\text{C}- \end{array} \text{ (ketone)}$	-0.50	350
-COOH (acid)	-0.90	770

Table for Liquid Thermal Conductivity

Table of H Factors

Functional Group	Number of Groups	H
Unbranched hydrocarbons		
Paraffins		0
Olefins		0
Rings		0
CH ₃ branches	1	1
	2	2
	3	3
C ₂ H ₅ branches	1	2
i-C ₃ H ₇ branches	1	2
C ₄ H ₉ branches	1	2
F substitutions	1	1
	2	2
Cl substitutions	1	1
	2	2
	3 or 4	3
Br substitutions	1	4
	2	6
I substitutions	1	5
OH substitutions	1 (iso)	1
	1 (normal)	-1
	2	0
Oxygen substitutions		
$\begin{array}{c} \text{O} \\ \\ -\text{C}- \end{array} \text{ (ketones, aldehydes)}$	1 (tertiary)	5
		0
$\begin{array}{c} \text{O} \\ \\ -\text{C}-\text{O}- \end{array} \text{ (acids, esters)}$		0
-O- (ethers)		2
NH ₂ substitutions	1	1

Table for Critical Properties

Table of Increments

Type of Increment	delta T	delta P	delta V
Nonring Increments			
$-\text{CH}_3$	0.020	0.227	55
$-\text{CH}_2$	0.020	0.227	55
$-\text{CH}$	0.012	0.210	51
$-\text{C}-$	0.000	0.210	41
$=\text{CH}_2$	0.018	0.198	45
$=\text{CH}$	0.018	0.198	45
$=\text{C}-$	0.000	0.198	36
$=\text{C}=\text{C}=\text{C}$	0.000	0.198	36
$\equiv\text{CH}$	0.005	0.153	(36)
$\equiv\text{C}-$	0.005	0.153	(36)

Type of Increment	delta T	delta P	delta V
Ring Increments			
$-\text{CH}_2-$	0.013	0.184	44.5
$-\text{CH}$	0.012	0.192	46
$-\text{C}-$	(-0.007)	(0.154)	(31)
$=\text{CH}$	0.011	0.154	37
$=\text{C}-$	0.011	0.154	36
$=\text{C}=\text{C}=\text{C}$	0.011	0.154	36
Halogen Increments			
$-\text{F}$	0.018	0.224	18
$-\text{Cl}$	0.017	0.320	49
$-\text{Br}$	0.010	(0.50)	(70)
$-\text{I}$	0.12	(0.83)	(95)

(continued)

Table for Critical Properties (Continued)

Table of Increments (Continued)

Type of Increment	delta T	delta P	delta V
Oxygen Increments			
—OH (alcohols)	0.082	0.06	18
—OH (phenols)	0.031	(-0.02)	(3)
—O— (nonring)	0.021	0.16	20
—O— (ring)	(0.014)	(0.12)	(8)
$\begin{array}{c} \\ \text{—C=O (nonring)} \end{array}$	0.040	0.29	60
$\begin{array}{c} \\ \text{—C=O (ring)} \end{array}$	(0.033)	(0.2)	(50)
$\begin{array}{c} \\ \text{HC=O (aldehyde)} \end{array}$	0.048	0.33	73
—COOH (acid)	0.085	(0.4)	80
—COO— (ester)	0.047	0.47	80
=O (except for combinations above)	(0.02)	(0.12)	(11)
Sulfur Increments			
—SH	0.015	0.27	55
—S— (nonring)	0.015	0.27	55
—S— (ring)	(0.008)	(0.24)	(45)
=S	(0.003)	(0.24)	(47)

Type of Increment	delta T	delta P	delta V
Nitrogen Increments			
—NH ₂	0.031	0.095	28
$\begin{array}{c} \\ \text{—NH (nonring)} \end{array}$	0.031	0.135	(37)
$\begin{array}{c} \\ \text{—NH (ring)} \end{array}$	(0.024)	(0.09)	(27)
$\begin{array}{c} \\ \text{—N— (nonring)} \end{array}$	0.014	0.17	(42)
$\begin{array}{c} \\ \text{—N— (ring)} \end{array}$	(0.007)	(0.13)	(32)
—CN	(0.060)	(0.36)	(80)
—NO ₂	(0.055)	(0.42)	(78)
Miscellaneous			
$\begin{array}{c} \\ \text{—Si—} \\ \end{array}$	0.03	(0.54)	—
$\begin{array}{c} \text{—B—} \\ \end{array}$	(0.03)	—	—
$\begin{array}{c} \vee \\ \text{C—H condensed} \\ \end{array}$ (common to two saturated rings)	(0.064)	—	—

Tables for Specific Heat

Table of Cp0

Tr	Pr 0.010	0.050	0.100	0.200	0.400
0.30	2.805	2.807	2.809	2.814	2.830
0.35	2.808	2.810	2.812	2.815	2.823
0.40	2.925	2.926	2.928	2.933	2.935
0.45	2.989	2.990	2.990	2.991	2.993
0.50	3.006	3.005	3.004	3.003	3.001
0.55	0.118	3.002	3.000	2.997	2.990
0.60	0.089	3.009	3.006	2.997	2.990
0.65	0.069	0.387	3.047	3.036	3.014
0.70	0.054	0.298	0.687	3.138	3.099
0.75	0.044	0.236	0.526	3.351	3.284
0.80	0.036	0.191	0.415	1.032	3.647
0.85	0.030	0.157	0.336	0.794	4.404
0.90	0.025	0.131	0.277	0.633	1.858
0.93	0.023	0.118	0.249	0.560	1.538
0.95	0.021	0.111	0.232	0.518	1.375
0.97	0.020	0.104	0.217	0.480	1.240
0.98	0.019	0.101	0.210	0.463	1.181
0.99	0.019	0.098	0.204	0.447	1.126
1.00	0.018	0.095	0.197	0.431	1.076
1.01	0.018	0.092	0.191	0.417	1.029
1.02	0.017	0.089	0.185	0.403	0.986
1.05	0.016	0.082	0.169	0.365	0.872
1.10	0.014	0.071	0.147	0.313	0.724
1.15	0.012	0.063	0.128	0.271	0.612
1.20	0.011	0.055	0.113	0.237	0.525
1.30	0.009	0.044	0.089	0.185	0.400
1.40	0.007	0.036	0.072	0.149	0.315
1.50	0.006	0.029	0.060	0.122	0.255
1.60	0.005	0.025	0.050	0.101	0.210
1.70	0.004	0.021	0.042	0.086	0.176
1.80	0.004	0.018	0.036	0.073	0.150
1.90	0.003	0.016	0.031	0.063	0.129
2.00	0.003	0.014	0.027	0.055	0.112
2.20	0.002	0.011	0.021	0.043	0.086
2.40	0.002	0.009	0.017	0.034	0.069
2.60	0.001	0.007	0.014	0.028	0.056
2.80	0.001	0.006	0.012	0.023	0.046
3.00	0.001	0.005	0.010	0.020	0.039
3.50	0.001	0.003	0.007	0.013	0.027
4.00	0.000	0.002	0.005	0.010	0.019

Table of Cp0

Tr	Pr 0.600	0.800	1.000	1.200	1.500
0.30	2.842	2.854	2.866	2.878	2.896
0.35	2.835	2.844	2.853	2.861	2.875
0.40	2.940	2.945	2.951	2.956	2.965
0.45	2.995	2.997	2.999	3.002	3.006
0.50	3.000	2.998	2.997	2.996	2.995
0.55	2.984	2.978	2.973	2.968	2.961
0.60	2.984	2.978	2.952	2.942	2.927
0.65	2.993	2.973	2.955	2.938	2.914
0.70	3.065	3.033	3.003	2.975	2.937
0.75	3.225	3.171	3.112	3.076	3.015
0.80	3.537	3.440	3.354	3.277	3.176
0.85	4.158	3.957	3.790	3.647	3.470
0.90	5.679	5.095	4.677	4.359	4.00
0.93	4.208	6.720	5.766	5.149	4.533
0.95	3.341	9.316	7.127	6.010	5.050
0.97	2.778	9.585	10.011	7.451	5.785
0.98	2.563	7.350	13.270	8.611	6.279
0.99	2.378	6.038	21.948	10.362	6.897
1.00	2.218	5.156	Undef.	13.281	7.686
1.01	2.076	4.516	22.295	18.967	8.708
1.02	1.951	4.025	13.184	31.353	10.062
1.05	1.648	3.047	6.458	20.234	16.457
1.10	1.297	2.168	3.649	6.510	13.256
1.15	1.058	1.670	2.553	3.885	6.985
1.20	0.885	1.345	1.951	2.758	4.430
1.30	0.651	0.946	1.297	1.711	2.458
1.40	0.502	0.711	0.946	1.208	1.650
1.50	0.399	0.557	0.728	0.912	1.211
1.60	0.326	0.449	0.580	0.719	0.938
1.70	0.271	0.371	0.475	0.583	0.752
1.80	0.229	0.311	0.397	0.484	0.619
1.90	0.196	0.265	0.336	0.409	0.519
2.00	0.170	0.229	0.289	0.350	0.443
2.20	0.131	0.175	0.220	0.265	0.334
2.40	0.104	0.138	0.173	0.208	0.261
2.60	0.084	0.112	0.140	0.168	0.210
2.80	0.070	0.093	0.116	0.138	0.172
3.00	0.058	0.078	0.097	0.116	0.144
3.50	0.040	0.053	0.066	0.079	0.098
4.00	0.029	0.038	0.048	0.057	0.071

(continued)

Tables for Specific Heat (Continued)

Table of Cp0 (Continued)

Tr	Pr 2.000	3.000	5.000	7.000	10.000
0.30	2.927	2.989	3.122	3.257	3.466
0.35	2.897	2.944	3.042	3.145	3.313
0.40	2.979	3.014	3.085	3.164	3.293
0.45	3.014	3.032	3.079	3.135	3.232
0.50	2.995	2.999	3.019	3.054	3.122
0.55	2.951	2.938	2.934	2.947	2.988
0.60	2.907	2.874	2.840	2.831	2.847
0.65	2.878	2.822	2.753	2.720	2.709
0.70	2.881	2.792	2.681	2.621	2.582
0.75	2.928	2.795	2.629	2.537	2.469
0.80	3.038	2.838	2.601	2.473	2.373
0.85	3.240	2.931	2.599	2.427	2.292
0.90	3.585	3.096	2.626	2.399	2.227
0.93	3.902	3.236	2.657	2.392	2.195
0.95	4.180	3.351	2.684	2.391	2.175
0.97	4.531	3.486	2.716	2.393	2.159
0.98	4.743	3.560	2.733	2.395	2.151
0.99	4.983	3.641	2.752	2.398	2.144
1.00	5.255	3.729	2.773	2.401	2.138
1.01	5.569	3.821	2.794	2.405	2.131
1.02	5.923	3.920	2.816	2.408	2.125
1.05	7.296	4.259	2.816	2.408	2.125
1.10	9.787	4.927	3.033	2.462	2.093
1.15	9.094	5.535	3.186	2.508	2.093
1.20	6.911	5.710	3.326	2.555	2.079
1.30	3.850	4.793	3.452	2.628	2.077
1.40	2.462	3.573	3.282	2.626	2.068
1.50	1.747	2.647	2.917	2.525	2.038
1.60	1.321	2.016	2.508	2.347	1.978
1.70	1.043	1.586	2.128	2.130	1.889
1.80	0.848	1.282	1.805	1.907	1.778
1.90	0.706	1.060	1.538	1.696	1.656
2.00	0.598	0.893	1.320	1.505	1.531
2.20	0.446	0.661	0.998	1.191	1.292
2.40	0.347	0.510	0.779	0.956	1.086
2.60	0.278	0.407	0.624	0.780	0.917
2.80	0.227	0.332	0.512	0.647	0.779
3.00	0.190	0.277	0.427	0.545	0.668
3.50	0.128	0.187	0.289	0.374	0.472
4.00	0.093	0.135	0.209	0.272	0.350

Table of Cp1

Tr	Pr 0.010	0.050	0.100	0.200	0.400
0.30	8.462	8.445	8.424	8.381	8.281
0.35	9.775	9.762	9.746	9.713	9.646
0.40	11.494	11.484	11.471	11.438	11.394
0.45	12.651	12.643	12.633	12.613	12.573
0.50	13.111	13.106	13.099	13.084	13.055
0.55	0.511	13.035	13.030	13.021	13.002
0.60	0.345	12.679	12.675	12.668	12.653
0.65	0.242	1.518	12.148	12.145	12.137
0.70	0.174	1.026	2.698	11.557	11.564
0.75	0.129	0.726	1.747	10.967	10.995
0.80	0.097	0.532	1.212	3.511	10.490
0.85	0.075	0.399	0.879	2.247	9.999
0.90	0.058	0.306	0.658	1.563	5.486
0.93	0.050	0.263	0.560	1.289	3.890
0.95	0.046	0.239	0.505	1.142	3.215
0.97	0.042	0.217	0.456	1.018	2.712
0.98	0.040	0.207	0.434	0.962	2.506
0.99	0.038	0.198	0.414	0.911	2.324
1.00	0.037	0.189	0.394	0.863	2.162
1.01	0.035	0.181	0.376	0.819	2.016
1.02	0.034	0.173	0.359	0.778	1.884
1.05	0.030	0.152	0.313	0.669	1.559
1.10	0.024	0.123	0.252	0.528	1.174
1.15	0.020	0.101	0.205	0.424	0.910
1.20	0.016	0.083	0.168	0.345	0.722
1.30	0.012	0.058	0.116	0.235	0.476
1.40	0.008	0.042	0.083	0.166	0.329
1.50	0.006	0.030	0.061	0.120	0.235
1.60	0.005	0.023	0.045	0.089	0.173
1.70	0.003	0.017	0.034	0.068	0.130
1.80	0.003	0.013	0.027	0.052	0.100
1.90	0.002	0.011	0.021	0.041	0.078
2.00	0.002	0.008	0.017	0.032	0.062
2.20	0.001	0.005	0.011	0.021	0.040
2.40	0.001	0.004	0.007	0.014	0.028
2.60	0.001	0.003	0.005	0.010	0.020
2.80	0.000	0.002	0.004	0.008	0.014
3.00	0.000	0.001	0.003	0.006	0.011
3.50	0.000	0.001	0.002	0.003	0.006
4.00	0.000	0.001	0.001	0.002	0.004

(continued)

Tables for Specific Heat (Continued)

Table of Cp1 (Continued)

Tr	Pr 0.600	0.800	1.000	1.200	1.500
0.30	8.192	8.102	8.011	7.920	7.785
0.35	9.568	9.499	9.430	9.360	9.256
0.40	11.343	11.291	11.240	11.188	11.110
0.45	12.532	12.492	12.451	12.409	12.347
0.50	13.025	12.995	12.964	12.933	12.886
0.55	12.981	12.961	12.939	12.917	12.882
0.60	12.637	12.620	12.589	12.574	12.550
0.65	12.128	12.117	12.105	12.092	12.060
0.70	11.563	11.559	11.553	11.536	11.524
0.75	11.011	11.019	11.024	11.022	11.013
0.80	10.536	10.566	10.583	10.590	10.587
0.85	10.153	10.245	10.297	10.321	10.324
0.90	9.793	10.180	0.349	10.409	10.401
0.93	Undef.	10.285	0.769	10.875	10.801
0.95	9.389	9.993	1.420	11.607	11.387
0.97	6.588	Undef.	3.001	Undef.	12.498
0.98	5.711	Undef.	Undef.	Undef.	Undef.
0.99	5.027	Undef.	Undef.	Undef.	Undef.
1.00	4.477	10.511	Undef.	Undef.	Undef.
1.01	4.026	8.437	Undef.	Undef.	Undef.
1.02	3.648	7.044	Undef.	Undef.	Undef.
1.05	2.812	4.679	7.173	2.277	Undef.
1.10	1.968	2.919	3.877	4.002	3.927
1.15	1.460	2.048	2.587	2.844	2.236
1.20	1.123	1.527	1.881	2.095	1.962
1.30	0.715	0.938	1.129	1.264	1.327
1.40	0.484	0.624	0.743	0.833	0.904
1.50	0.342	0.437	0.517	0.580	0.639
1.60	0.249	0.317	0.374	0.419	0.466
1.70	0.187	0.236	0.278	0.312	0.349
1.80	0.143	0.180	0.212	0.238	0.267
1.90	0.111	0.140	0.164	0.185	0.209
2.00	0.088	0.110	0.130	0.146	0.166
2.20	0.057	0.072	0.085	0.096	0.110
2.40	0.039	0.049	0.058	0.066	0.076
2.60	0.028	0.035	0.042	0.048	0.056
2.80	0.021	0.026	0.031	0.036	0.042
3.00	0.016	0.020	0.024	0.028	0.033
3.50	0.009	0.012	0.015	0.017	0.021
4.00	0.006	0.008	0.010	0.012	0.015

Table of Cp1 (Continued)

Tr	Pr 2.000	3.000	5.000	7.000	10.000
0.30	7.558	7.103	6.270	5.372	4.020
0.35	9.080	8.728	8.013	7.290	6.285
0.40	10.980	10.709	10.170	9.625	8.803
0.45	12.243	12.029	11.592	11.183	10.533
0.50	12.805	12.639	12.288	11.946	11.419
0.55	12.823	12.695	12.407	12.103	11.673
0.60	12.506	12.407	12.165	11.905	11.526
0.65	12.026	11.943	11.728	11.494	11.141
0.70	11.495	11.416	11.208	10.985	10.661
0.75	10.986	10.898	10.677	10.448	10.132
0.80	10.556	10.446	10.176	9.917	9.591
0.85	10.278	10.111	9.740	9.433	9.075
0.90	10.279	9.940	9.389	8.999	8.592
0.93	10.523	9.965	9.225	8.766	8.322
0.95	10.865	10.055	9.136	8.621	8.152
0.97	11.445	10.215	9.061	8.485	7.986
0.98	11.856	10.323	9.037	8.420	7.905
0.99	12.388	10.457	9.011	8.359	7.826
1.00	13.081	10.617	8.990	8.293	7.747
1.01	Undef.	10.805	8.973	8.236	7.670
1.02	Undef.	11.024	8.960	8.182	7.595
1.05	Undef.	11.852	8.939	8.018	7.377
1.10	Undef.	Undef.	8.933	7.759	7.031
1.15	7.716	12.812	8.849	7.504	6.702
1.20	2.965	9.494	8.508	7.206	6.384
1.30	1.288	3.855	6.758	6.365	5.735
1.40	0.905	1.652	4.524	5.193	5.035
1.50	0.666	0.907	2.823	3.944	4.289
1.60	0.499	0.601	1.755	2.781	3.545
1.70	0.380	0.439	1.129	2.060	2.867
1.80	0.296	0.337	0.764	1.483	2.287
1.90	0.234	0.267	0.545	1.085	1.817
2.00	0.187	0.217	0.407	0.812	1.446
2.20	0.126	0.150	0.256	0.492	0.941
2.40	0.089	0.109	0.180	0.329	0.644
2.60	0.066	0.084	0.137	0.239	0.466
2.80	0.051	0.067	0.110	0.187	0.356
3.00	0.041	0.055	0.092	0.153	0.285
3.50	0.026	0.038	0.067	0.108	0.190
4.00	0.019	0.029	0.054	0.085	0.146

List of Entries and Results

Label	Meaning	English Units	Metric Units
A	if in heat exchanger, area if in specific heat, Cp coefficient if in distillation, ratio of reflux ratios	ft ²	m ²
B	Cp coefficient		dimensionless
BAF	baffle pitch	ft	m
Bot	K-value at bottoms		dimensionless
BSP	baffle spacing	in	m
C	Cp coefficient		cal/g°C
Cp	if gas, gas specific heat if heat transfer, specific heat	BTU/lb °F	cal/g°C
CpA	Cp coefficient		
CpB	Cp coefficient		
CpC	Cp coefficient		
CpC	cold fluid specific heat	BTU/lb °F	cal/g°C
CpD	Cp coefficient		
Cpg	gas specific heat	cal/g°C	
Cph	hot fluid specific heat	BTU/lb °F	cal/g°C
Cpl	if in specific heat, liquid Cp if in absorber design, liquid Cp	BTU/lb mole °F	cal/gmole °C
Cpn	Cp coefficient		
Cpv	vapor Cp	BTU/lb mole °F	cal/gmole °C
Cp0	value from Cp0 table		
Cp1	value from Cp1 table		
#C	number of components		dimensionless
D	Cp coefficient		dimensionless
DEL	deltas		dimensionless
DIA	pipe or tube inside diameter	ft	m
dP	if in pipe design, change in pressure if in heat exchanger, change in pressure if in critical properties, delta P from Table of Increments	lb/in ²	KPa
dT	delta T from Table of Increments		dimensionless
dt	change in temperature	°F	°C
dV	delta V from Table of Increments		dimensionless
dZ	change in elevation	ft	m
e	pipe roughness	ft	m
EFF	tray efficiency		dimensionless
f	recovery factor		dimensionless
Fd	K-value at feed		dimensionless
Frac	mole fraction		dimensionless
frC	mole fraction		dimensionless
Ft	heat exchanger configuration		dimensionless
Ft1	1-2 heat exchanger Ft		dimensionless
Ft2	2-4 heat exchanger Ft		dimensionless
G	liquid activity coefficient		dimensionless

Label	Meaning	English Units	Metric Units
GCa	a group contributions from Table of Group Contributions		dimensionless
Gcb	b group contributions from Table of Group Contributions		dimensionless
GLB	number of globe valves		dimensionless
GTE	number of gate valves		dimensionless
H	H factor from Table of H Factors		dimensionless
h	heat transfer coefficient		
hio	inside initial heat transfer coefficient	BTU/hr ft ² °F	Watt/m ² °C
ho	outside initial heat transfer coefficient		
HTw	wall height	in	m
Hv	if in absorber design, heat of vaporization if in heat transfer, heat of vaporization	BTU/lb mole	cal/g mole
Hvb	heat of vaporization at the normal boiling temperature	BTU/lb	KJoule/Kg
Hvt	heat of vaporization at the given temperature		cal/g
i	first subscript in interaction		dimensionless
ID	shell or tube inside diameter	in	m
IDp	pipe inside diameter	ft	m
IDs	shell inside diameter	ft	m
inc	number of increments		dimensionless
j	second subscript in interaction		dimensionless
K	if in absorber design, Depriester K-value if in distillation or eq. flash, relative volatility		dimensionless
k	thermal conductivity	BTU/hr ft °F	Watt/m °C
Khk	K-value of the heavy key		dimensionless
Klk	K-value of the light key		dimensionless
Kr	Raoult's law K-value		dimensionless
L	if subscripted, binary interaction otherwise, number of L bends		dimensionless
LAMBDA	thermal conductivity		dimensionless
LEN	if in pipe design or heat exchanger geometry, pipe or exchanger length	ft	m
	if in heat exchanger pressure drop, exchanger length	in	m
lFd	liquid feed rate		moles/time
liq	if in absorber design, mole fraction of entering liquid if in equilibrium flash, production rate of liquid or mole fraction of exiting liquid		dimensionless
LK	designation of light key comp.		dimensionless

(continued)

List of Entries and Results (Continued)

Label	Meaning	English Units	Metric Units
lx1	exiting liquid quantity		moles/time
MdT	log mean temperature difference	°F	°C
mol	feed rate		moles/time
MU	if gas, gas viscosity		micropoise
	if liquid, liquid viscosity		centipoise
	if in pipe design, heat exchanger, or heat transfer, liquid viscosity	lb/ft hr	centipoise
MUhi	high pressure gas viscosity		micropoise
MUlo	low pressure gas viscosity		micropoise
MU1	viscosity of first liquid		centipoise
MU2	viscosity of second liquid		centipoise
Mw	molecular weight		dimensionless
N	number of trays		dimensionless
n	if in specific heat, Cp coefficient		
	if in liquid viscosity, number of carbon atoms		dimensionless
	if in critical properties, number of occurrences of an increment		dimensionless
	otherwise, number of components		dimensionless
Nmn	minimum number of trays		dimensionless
OD	outside diameter	in	m
ODt	tube outside diameter	ft	m
P	if unsubscripted, system pressure		atm
	if subscripted, fugacity coefficient		dimensionless
Pc	critical pressure		atm
PIT	pitch of tube centers	in	m
Pr	reduced pressure		dimensionless
Pv	vapor pressure		atm
#P	number of passes		dimensionless
Q	if in pipe design, flow rate	gal/min	m ³ /min
	if in heat exchanger, heat transfer rate	BTU/hr	Watts
q	feed condition		dimensionless
R	heat exchanger parameter for finding Ft		dimensionless
Rd	dirt factor	hr ft ² °F	m ² °C
		BTU	Watt
RHO	if in pipe design or heat exchanger, density	lb/ft ³	g/cm ³
	if in gas viscosity, gas density		g mole/cm ³
	otherwise, density		g/cm ³
Rmn	minimum reflux ratio		dimensionless
ROl	liquid density		g/cm ³
ROv	vapor density		g/cm ³

Label	Meaning	English Units	Metric Units
RO1	density of first liquid		g/cm ³
RO2	density of second liquid		g/cm ³
S	heat exchanger parameter for finding Ft		dimensionless
spg	specific gravity		dimensionless
t	system temperature		°C
tb	boiling temperature		°C
tc	critical temperature		°C
tc1	incoming cold fluid temperature	°F	°C
tco	outgoing cold fluid temperature	°F	°C
TH	theta, total of structural contributions		dimensionless
thi	incoming hot fluid temperature	°F	°C
tho	outgoing hot fluid temperature	°F	°C
tlq	entering liquid temperature	°F	°C
Tr	reduced temperature		dimensionless
tvp	entering vapor temperature	°F	°C
TUB	tube pitch	ft	m
T->	number of T's entering run		dimensionless
->T	number of T's entering branch		dimensionless
#T	number of tubes		dimensionless
#Tr	number of trays		dimensionless
U	number of U bends		dimensionless
Ud	dirt-compensated design coefficient	BTU hr ft ² °F	Watt m ² °C
Uo	overall design coefficient		
Vap	K-value at vapor line		dimensionless
vap	if in absorber design, mole fraction of entering vapor		dimensionless
	if in equilibrium flash, production rate of vapor or mole fraction of exiting vapor		moles/time
Vc	critical volume		dimensionless
vFd	vapor feed rate		cm ³ /gram mole
vyN	exiting vapor flow rate		moles/time
w	if in heat exchanger or heat transfer, flow rate	lb/hr	Kg/hr
	otherwise, acentric factor		dimensionless
wc	cold fluid flow rate	lb/hr	Kg/hr
wh	hot fluid flow rate	lb/hr	Kg/hr
x	mole fraction		dimensionless
Xdi	mole fraction in distillate		dimensionless
Xfd	mole fraction in feed		dimensionless
Xhk	mole fraction of heavy key		dimensionless
Xlk	mole fraction of light key		dimensionless
x1	mole fraction of first liquid		dimensionless
Z	compressibility factor		dimensionless
Zc	critical compressibility factor		dimensionless
Zra	Rackett's parameter		dimensionless
#	number of compound		dimensionless